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HARVESTING MALTING BARLEY

Bulletin No. 5
February 1st, 1957

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THE BREWING AND MALTING BARLEY RESEARCH INSTITUTE

206 Grain Exchange Building
WINNIPEG 2 - CANADA

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Harvesting Malting Barley

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Foreword

The Brewing and Malting Barley Research Institute is charged by the Brewing and Malting Industries with the improvement of the yield per acre and malting quality of barley. In this era of "scientific and mechanized" farming, the barley grower must be able to apply scientific methods to all his operations, and to use to best advantage the machines that the engineers have developed. Since a great loss occurs in threshing malting barley, the Institute has prevailed upon the Agricultural Engineers in the three prairie universities and in the Experimental Farms Service of the Canada Department of Agriculture to prepare a bulletin on the adjusting of the swather and combine for harvesting malting barley.

The Institute suggests that all malting barley growers read, study, and put into practice the recommendations that are described in this bulletin.

DR. T. J. HARRISON, Director,
Brewing and Malting Barley Research Institute.

Loss Due to Improper Combine Adjustments

The malting barley growers in Western Canada lose large sums of money every year from faulty swathing and combining technique. It has been estimated that the loss due to this cause has amounted to as much as \$1,500,000 per year. If a combine threshes 1,000 bushels per day and it causes peeling and cracking to the extent of over 8 per cent of the kernels, the loss would be 19 cents per bushel or \$190.00 per day. This is calculated on the Wheat Board selling price on June 5th, 1956, plus the five cent premium for malting barley.

The percentage of close threshed, peeled and broken kernels allowable in the various grades of malting barley is fixed by the Board of Grain Commissioners for Canada.

Percentage of Peeled and Broken Kernels

GRADE	Maximum Percentage of Peeled and Broken Kernels
No. 1 Canada Western Six-row	3%
No. 2 Canada Western Six-row	5%
No. 3 Canada Western Six-row	5%
No. 4 Canada Western Six-row	8%

The price of barley grades is made up by the quoted price plus five cents per bushel on all barley selected by the domestic maltsters and barley exporters. As an example, the following table gives the Canadian Wheat Board selling price plus the five cents premium. This would be the price received by the grower as at Fort William and Port Arthur less the usual charges for freight, handling, grading and Wheat Board charges.

Grades and Price (As at June 5th, 1956)

GRADE	PREMIUM	PRICE	TOTAL PRICE
No. 1 C.W. Six-row	5 cents	119½	124½
No. 2 C.W. Six-row	5 cents	119½	124½
No. 3 C.W. Six-row	5 cents	115½	120½
No. 4 C.W. Six-row	5 cents	107	112
No. 1 Feed	0	105½	105½
No. 2 Feed	0	105	105
No. 3 Feed	0	101¾	101¾

Thus the loss on a carload of 2,500 bushels would be about 19 cents per bushel or on the carload \$475.00.

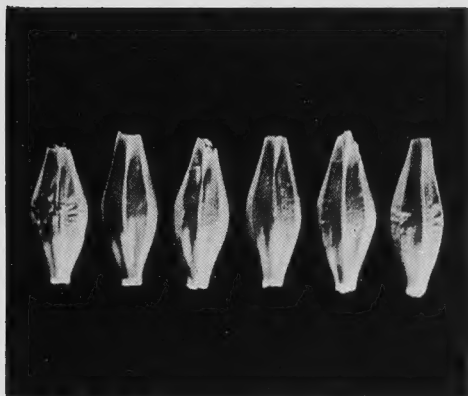
Quality Barley

To produce good malting barley, the kernels must not be broken or peeled in combining, threshing, or subsequent handling. The reason for this is that in the malting process, the barley is "grown" or germinated and if the kernel is broken, it will impair the germination.

When barley is germinating, the shoot or young stem grows back under the hull from the germ end and emerges at the other end of the kernel. To make good malt, the shoot must be protected by the hull. If the kernel is peeled or even partially peeled (closely threshed), the shoot will break off and be lost when the malt is dried and the rootlets removed.

Figure 1

Good Quality Malting Barley



Properly matured, well-threshed kernels.

The quality of barley the grower should strive for, grades No. 1 C.W. Six-row. Sells often for as much as 14 cents per bushel over No. 1 Feed plus the 5 cents per bushel malting premium.

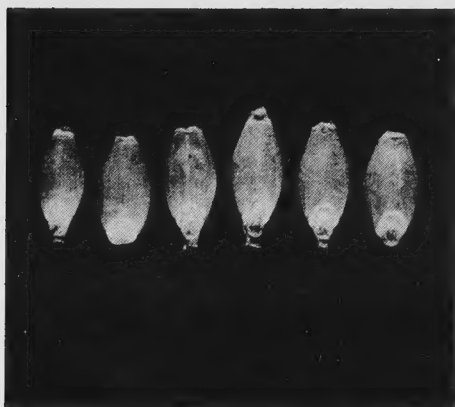


Good quality malting barley produces a strong, uniform "growth" or germination. This quality of barley will help expand the market for Canadian malt and malting barley.



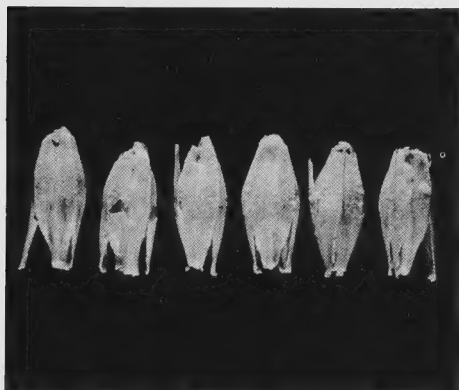
Figure 2

Peeled and Partially Peeled Barley



Peeled kernels; many are injured and will not germinate.

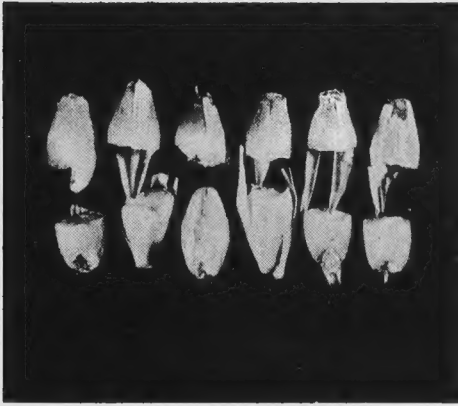
Good malting barley that would have graded No. 1 C.W. Six-row but was damaged in threshing with over 8 per cent peeled and partially peeled kernels, and actually graded No. 1 Feed.



Partially peeled barley may not germinate and, if it does, the sprout will protrude and be lost.

Figure 3

Broken Barley



Broken kernels—at least one-half of the endosperm end of the kernel cannot germinate and the starch cannot be converted to sugar.

Good malting barley that should have graded No. 2 C.W. Six-row but was damaged in threshing and will grade only No. 1 Feed. There is over 8 per cent peeled, broken and cracked kernels.



Even with a small trace of peeling or close threshing, the ends of the kernels open up and give a "ragged" appearance to the malt and brewers may refuse to accept shipment of malt in this condition.

In the commercial grading of barley, 5 per cent peeling is allowed in No. 2 C.W. Six-row and No. 3 C.W. Six-row grades, but even this amount of peeling causes a loss and, if Canada is to establish a good domestic and export market for malt and malting barley, this peeling must be eliminated or at least materially reduced.

While some damage may occur in the handling of barley after threshing, the National Research Council, which investigated this some years ago, reported that if the grain was properly threshed, the handling damage was negligible; but if the grain was damaged in threshing, it got progressively worse each time it was handled. For example: barley, showing only 3 per cent of damaged kernels as it came from the threshing machine, contained 9 per cent of damaged kernels at the final destination.

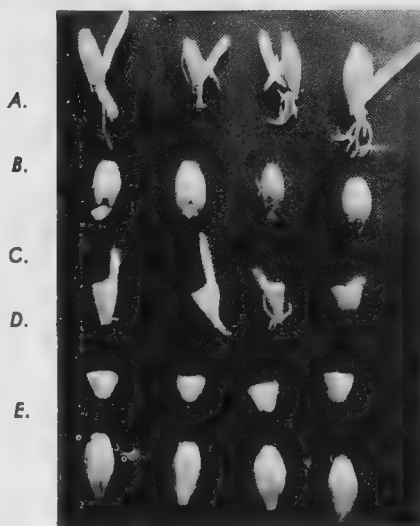
Figure 4

Broken, Peeled, and Partially Peeled Barley



Actual sample of good malting barley that should have graded No. 2 C.W. Six-row but was damaged in threshing. Note the 10 per cent or over of broken, peeled and partially peeled kernels that caused it to be graded No. 1 Feed.

- A. Peeled and partially peeled kernels with out-growing sprout.
- B. Peeled kernels with dead germs. Useless for malting and a source of injurious molds.
- C. Germ end "half corns" with out-growing sprout.
- D. Endosperm end "half corns," no sprout. Useless for malting and a source of injurious molds.
- E. Dead kernels. Useless for malting and a source of injurious molds.



Stage of Maturity

One of the most important properties in evaluating the malting quality of barley is maturity. Immature kernels do not convert properly in the malting process. Good malting barley must be plump and well matured. In order to obtain plump, well matured grain, the crop should not be harvested on the "green side" as is, all too frequently, done. This practice originated because of the tendency of many malting varieties to "shatter" or to "neck," particularly if the weather is dry and high winds prevalent. Like many of these practices, the immature harvesting of barley was sometimes carried to the extreme, with considerable loss to the grower. With the introduction of such varieties as Montcalm, Parkland and Olli, the crop may be allowed to become ripener than is the case with some of the other malting varieties.

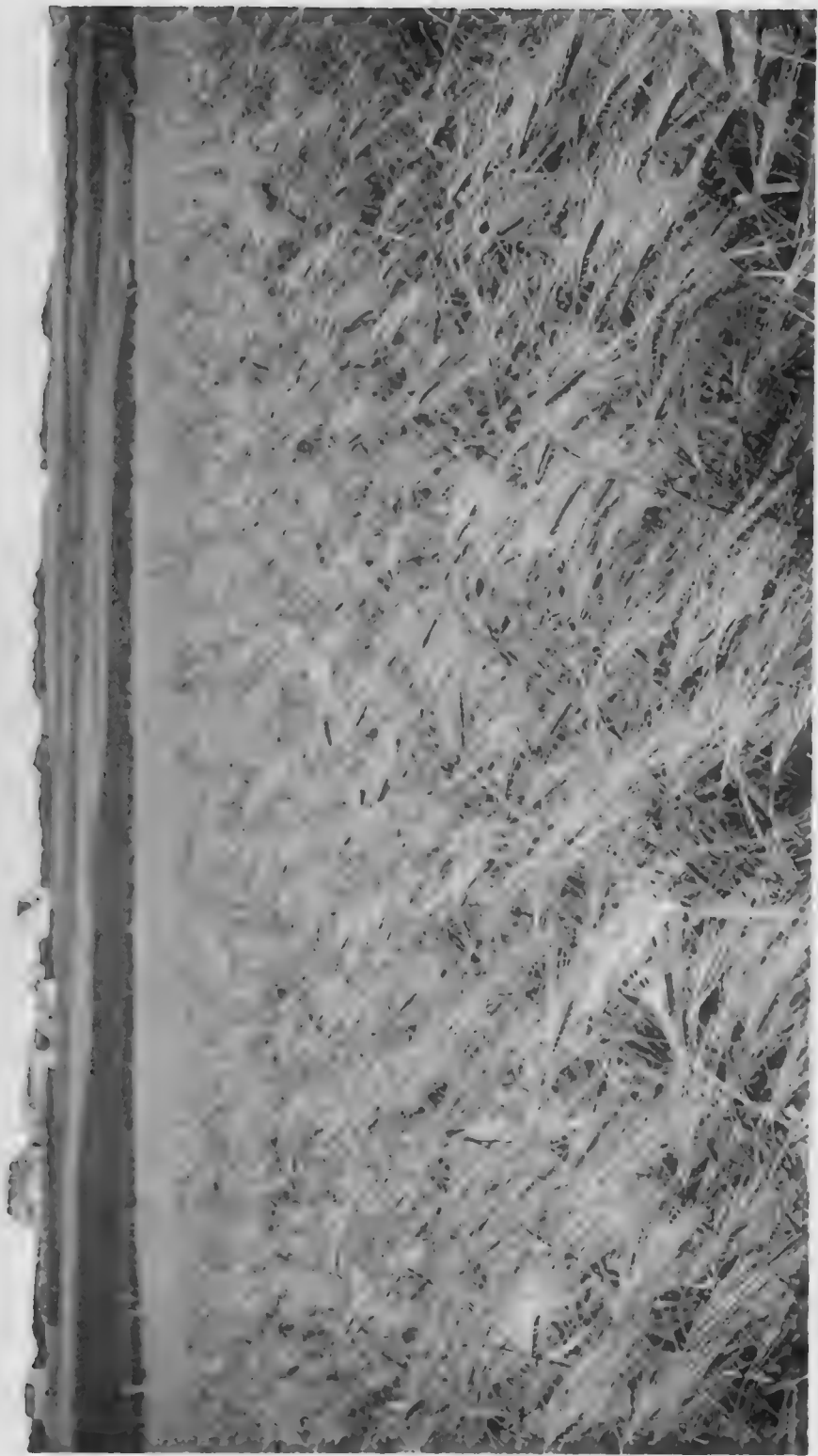


FIGURE 5 — A well matured field of barley ready to swath — Birtle, Manitoba.

Swathing Practices

Good malting barley should be of a rich golden color. Proper swathing practices will help assure that this quality is reached.

Swathing is dependent upon a good stand of grain seeded in such a way as to provide stubble to support the swath. Barley should be seeded with an implement that will provide a drill spacing of not more than 6 inches. This will assure that the heads do not fall through the stubble to the ground and become discolored and damaged by soil moisture.

It is important that the width of swath be adjusted to the weight of the crop being harvested. A heavy crop may be placed in a wide swath, while a light crop must be held together in a narrow swath. The metal shield, which presses the stubble forward while the swath is being laid, should be carefully adjusted. The length of stubble should be ample to keep the swath off the ground, but not so long that it collapses under the weight of the swath. A recommended stubble length is not more than 8 inches and not less than 6 inches. A well supported swath is easily recovered with the combine pick-up.



FIGURE 6

Adjusting the height of cut for length of stubble when swathing.

Swathers usually fall into two general classes: those with a fixed table canvas speed and those which have the canvas driven from the grain wheel. A forward speed of travel should be selected so that ground speed and canvas speed can be related to assist in making a well bound swath.

Barley swathing may be started a week or so before the normally accepted stage of maturity for straight combining. The swath formed should be well bound so that the grain matures uniformly in a protected state. This will avoid

the losses incurred by early frosts, shattering due to rain and wind, and will eliminate the green weed problem associated with straight combining. The crop can be recovered from the swath as soon as the grain is dry, usually four or five days after cutting. This procedure often will advance the harvest as much as nine days ahead of straight combining.

When cut with the binder, sheaves of barley should be picked up immediately and placed in carefully formed stooks which will protect the grain from weather. Damage results from leaving the barley exposed to the weather or in contact with damp ground before stooking.

Barley Threshing

Many combine operators and threshermen believe that to make a good job of threshing barley, it must be threshed "close" so that it will weigh heavy per measured bushel. This is absolutely incorrect. While weight per bushel is important in grading, absence from peeling is much more important. Well threshed malting barley might have about 1/8 of an inch of awn. This is necessary to prevent peeling and to protect the kernel in subsequent handling. Some varieties thresh more easily than others. For example, among the malting varieties—O.A.C. 21, Olli and Parkland thresh better than Montcalm. The awns are more brittle and, therefore, break more easily and the hulls are more firmly attached to the kernel. Montcalm, on the other hand, has a tough



FIGURE 7
Picking up a well laid swath.

awn which tends to break close to the hull and frequently takes part of the hull with it, exposing the kernel and causing a peeled or "ragged" malt. Therefore, while all malting varieties require extreme care in threshing, this is particularly the case with regard to Montcalm.

Barley must not be combined or threshed before the moisture content of the kernel has been reduced by drying in the swath or stook to a level of 14.8 per cent or less. At this level of moisture content, it can be stored safely. If it is threshed or combined with more than this amount of moisture, it will be degraded to "tough," or if it contains more than 17 per cent moisture, it will be degraded to "damp."

When the kernel is of the right moisture content, best results will be obtained in threshing or combining when the hull is a little tough as a result of the dew. In other words, the best time of day in which to thresh barley is in the early morning or late evening.

Barley may well be picked up from the swath and combined at night so that the straw will be tough. The tough straw will act as a cushion for the dry kernels, preventing damage to the kernels when passing through the cylinder of the thresher or combine.

Feeding the Thresher or Combine

The threshing machine or combine should be fed slowly and evenly in keeping with the speed of the cylinder. When possible, the grain should be fed through the machine straw-first in order to cushion the threshing of the kernels. It must be remembered that when the cylinder speed is reduced, as suggested in the following paragraph, the capacity of the combine is reduced, resulting in the slowing down of the combine in the field. A great deal of barley threshing damage is done by trying to jam a large volume of grain through a cylinder operated at lower speeds than for wheat threshing.

Cylinder and Concave

The cylinder and concave are the heart of any threshing and separating mechanism. What happens at this point has a direct bearing on the operation of the straw rack and cleaning shoe. If the cylinder does not thresh the grain out of the heads there is nothing the other units of the machine can do about it. When the cylinder speed and concave adjustment causes the straw and weeds to be shredded excessively, this condition makes it very difficult for the straw rack to shake all the grain through. It overloads the shoe with material which should be carried over by the straw rack, making clean separation very difficult if not impossible. It also results in returning an excessive amount of chopped up straw, weeds and grain to the cylinder and in a loss of grain over the shoe. For these reasons, it is clear that the speed and concave adjustment are very important and determine to a great extent the quality of the threshing and separating which can be done. The speed of the cylinder and concave adjustment should in all cases be such that the grain is threshed from the heads without mutilating the straw any more than is necessary.

For threshing barley the cylinder speeds must be reduced. Excessive speed, over 6,000 fpm, will result in damage to the barley.

CYLINDER AND CONCAVE ADJUSTMENTS

Type of Cylinder	Cylinder & Concave Clearance	% Broken & Skinned Clearance Speed				Notes
		4700	5000	5800	6000	
RUBBER FACED BAR CYLINDER	¾ inch	1.0		2.0		*Speed Range: 4800-6000 FPM
	11/16 inch	1.0		2.0		
	¾ inch	1.0		3.0		*Range of Clearance: 5/16-¾ inch
	9/16 inch	1.0		3.3		
	¾ inch	1.0		5.0		*Best Speed: 5200 FPM
	7/16 inch	1.5		6.0		
	¾ inch	2.0		7.0		
	5/16 inch	3.0		9.0		
	¼ inch	4.0		—		
RASP BAR CYLINDER	¾ inch		2.0		3.2	*Speed Range: 4700-5800 FPM
	9/16 inch		2.0		5.0	
	¾ inch		2.0		6.5	*Range of Clearance: 5/16-¾ inch
	7/16 inch		2.3		8.0	
	¾ inch		2.5		10.0	Best combination is approximately 5000 FPM and ¾-½ inch clearance.
	5/16 inch		3.0		12.0	
	¼ inch		3.9		14.8	*Best Speed: 5100 FPM
	3/16 inch		5.0		17.5	
*Spike Tooth		*RANGE OF CLEARANCE 2-4 ROWS (Half Way Up To All The Way Down)				*Speed Range: 5400-6200 FPM
						*Best Speed: 5700 FPM

Controlled Tests of U. of Minnesota Experiment Station.
*Based on North Dakota Field Tests.

SAMPLING DATA AT VARIOUS CYLINDER SPEEDS

Combine	Sample	Cylinder Speed	Concave Clearance	Skinned & Broken	Notes
John Deere SP 55 Rasp Bar Cyl. 30" x 22"		RPM-FPM 1150-6612 1100-6325 1000-5750 925-5268	¾"	9.0% 7.0% 6.0% 4.8%	
John Deere 12A Rasp Bar Cylinder 60" x 15"	At 1150 RPM At 1150 RPM At 1000 RPM At 1000 RPM	1150 RPM reduced to 1000 RPM	¼"	17.5% 17.0% 5.8% 3.4%	• Tailings Return
McCormick-Deering Model 20A Spike Tooth Cylinder 22¾" x 14"	1 2 3	1100 RPM to 5181 FPM	4 Rows Concave Teeth	1.0% 1.5% 3.5%	Concaves: Set Halfway Open. Wind: More than Half- way Open. Sieves: Open. Return: Med.-Light. Straw: Tough.
IHB, No. 31 RD Rasp Bar Cylinder 28" x 20"	10.00 AM 11.00 AM 12.00 Noon 2.00 PM 3.00 PM 4.00 PM 5.00 PM	1050 RPM to 5701 FPM	½"	1.0% 1.0% 1.0% 1.6% 2.0% 3.0% 4.5%	
Minneapolis-Moline 12'5" Rasp Bar Cylinder 31¼" x 22¼"	3.30 PM 6.00 PM 10.00 AM 12.00 Noon 2.30 PM 5.00 PM	1100 RPM to 6420 FPM	5/16"	22.0% 26.0% 14.0% 17.0% 17.5% 20.0%	Tailings Return Heavy Small Amount Going Over.

A report made on work done at the University of Minnesota Experimental farm at Morris, gave the following results:

Type Cylinder	Range of Speeds	Best Speed	Range of Clearance	Best Clearance
Rubber-faced bar	4,700 to 6,000 fpm	5,100 fpm	5/16" to 1/2"	3/8"
Rasp bar	4,600 to 5,800 fpm	5,000 fpm	1/2" to 5/8"	1/2"
Spike tooth	5,600 to 6,400 fpm	5,600 fpm	2 rows { up med. down	2 rows up

The cylinder and concaves must be kept in good condition mechanically. The teeth must be straight and uniform. There should be very little end play on the spike tooth cylinder and the spacing on each side of the teeth should be the same.

In general the cylinder and concave should be set as open as possible without interfering with the removal of kernels from the head. Also, in the case of the spike tooth cylinder, as few rows of teeth in the concave should be used as will still remove the kernels from the head.

SHOE

The sieves should be adjusted for the least possible return. A great deal of damage is done when the return is heavy and a lot of the grain goes through the cylinder a second time.

The adjustable sieve should be opened to encourage grain to pass through the chaffer before reaching the return. Excessive damage resulting from trying to produce a very clean sample of barley when threshing can result in loss of the malting grade.

WIND

The wind should be directed to the front of the sieves to discourage a mat of beards and chaff from forming on the sieves. Plenty of wind should be used to lift the chaff and allow the barley kernels to fall through the sieve before they are carried into the tailings and back to the cylinder.

ELEVATING AND HANDLING EQUIPMENT

Elevators and augers on the combine should be checked as possible sources of damage to the grain. Bent elevator or auger housings may peel and crack the kernels.

Blower elevators can do excessive damage when run even slightly over their design speed.

	Blower Fan Speed	Skinned and Broken
Sample before blowing		.4%
Sample after blowing	900 rpm	.4%
Sample after blowing	1,100 rpm	1.0%
Sample after blowing	1,330 rpm	4.0%
Sample after blowing	1,440 rpm	6.0%

*Recommended speed for this blower is 850 to 900 rpm

SPEED OF CYLINDER BARS AS RELATED TO REVOLUTIONS PER MINUTE

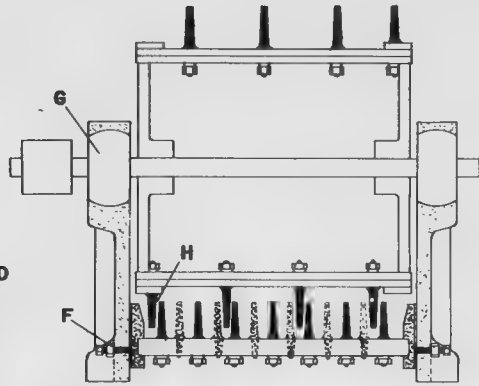
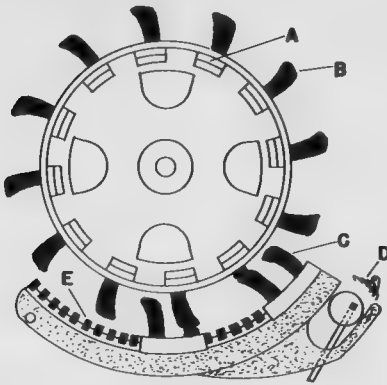
Speed of cylinder bars in feet per minute		5,000	5,200	5,400	5,600	5,800	6,000
Diameter of Cylinder (inches)	Revolutions per minute corresponding to above speeds						
15		1,272	1,322	1,373	1,425	1,477	1,528
16		1,192	1,240	1,290	1,336	1,385	1,432
17		1,122	1,167	1,212	1,256	1,300	1,377
18		1,060	1,100	1,143	1,186	1,230	1,272
19		1,002	1,042	1,083	1,122	1,164	1,204
20		957	992	1,032	1,071	1,110	1,146
21		908	945	982	1,018	1,155	1,091
22		867	902	937	972	1,006	1,042

APPROXIMATE DIAMETERS OF COMBINE CYLINDERS BY MAKES AND MODELS

Diameter (inches)	Make and Model	
15	Allis-Chalmers "66"; Cockshutt "422"; John Deere "25"; Massey-Harris "Clipper 50"; McCormick "76-7"; Oliver "18."	
16	Case "55."	
17	Minneapolis-Moline "H-69"; "88."	
18	Allis-Chalmers "100."	
19	Gleaner P-80; T-2, T-3, A, R, B; Case "110."	
20	McCormick "140"; "141"; Oliver "35."	
21	Case 120, 120R.	
22	Case "A," 75; Cockshutt "427," "428"; John Deere "65"; 45; 55; 55R.	
22	Massey-Harris "60"; P.T. (60SP, 80SP, 90SP); Minneapolis-Moline "G-4," "SP168."	

Types of Cylinder and Concaves

Spike Tooth Cylinder:



A—BARS TO HOLD CYLINDER TEETH

D—RATCHET LEVER & ECCENTRICS

F—ADJUSTMENT-SIDewise SETTING OF CONCAVES

B—STEEL CYLINDER TEETH

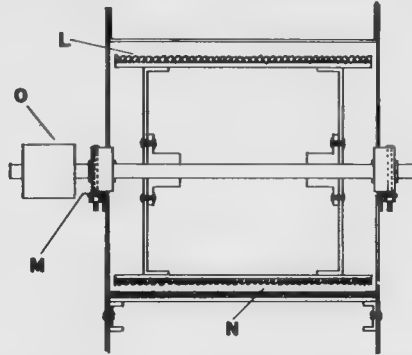
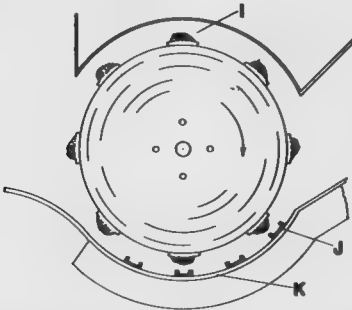
E—CONCAVES

G—CYLINDER BEARING

C—CONCAVE TEETH

H—THRESHING SPACES

Rasp Bar Cylinder:



I & L—CORRUGATED CYLINDER BARS

J—CHANNEL IRON CONCAVES

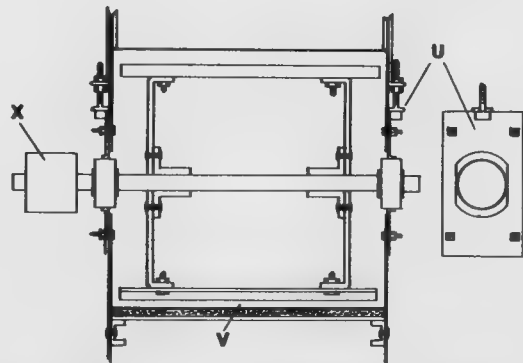
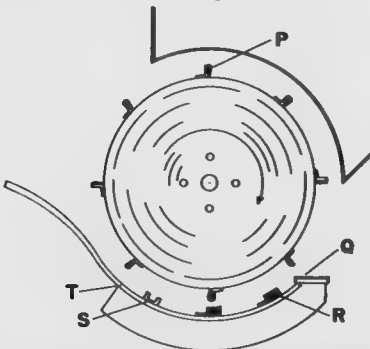
K—PERFORATED STEEL SCREEN

M—SPACER SHIMS FOR ADJUSTING CYLINDER TO CONCAVE CLEARANCE

N—CYLINDER CLEARANCE

O—PULLEY

Rubber-Faced Bar Cylinder:



P—RUBBER FACES

Q—RUBBER FACED SHELLING PLATE

R—STEEL JACKETED RUBBER BAR

S—CHANNEL IRON

T—PERFORATED STEEL SCREEN

U—CYLINDER CLEARANCE ADJUSTMENT

V—CYLINDER CLEARANCE

X—PULLEY



FIGURE 8 — Combining barley on farm of J. A. Rivard — Leduc, Alberta.

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Chairman of the Authors.





